

Notulae Crassulacearum Asiae Orientalis (3)

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Several taxa of *Rhodiola* (Crassulaceae) were examined mainly based on the authentic specimens. *Rhodiola tangutica* (Maxim.) S. H. Fu which has been often confused with *R. algida* (Ledeb.) Fisch. & C. A. Mey. in the subgenus *Crassipedes* is well distinguished by the dioecious nature and the combinations of several vegetative and floral characters, and classified in the subgenus *Rhodiola* (sect. *Rhodiola*). The revised description is provided. The synonymy of *Rhodiola krivochizhinii* Sipliv. with *R. rosea* is discussed again based on the examination of the type. *Sedum trollii* Werderm. is considered as the synonym of *Rhodiola pachyclados* (Aitch. & Hemsl.) H. Ohba.

Key words: Crassulaceae, *Sedum*, *Rhodiola*, taxonomy.

(7) *Rhodiola algida* (Ledeb.) Fisch. & C. A. Mey. and *R. tangutica* (Maxim.) S. H. Fu

The *Rhodiola* flora of Siberia is still controversial. One of the difficulties is the identity of *Rhodiola algida* (Ledeb.) Fisch. & C. A. Mey., and also the taxa described under, α . *altaicum*, β . *jeniseense* and γ . *tanguticum*, by Maximowicz (1883). Ohba (1980) revealed that *Rhodiola algida* has hermaphrodite flowers, and classified it in subgenus *Crassipedes*.

Rhodiola algida is related to *R. stephanii* (Chamisso) Trautv. & C. A. Mey. and *R. dumulosa* (Franch.) S. H. Fu. *Rhodiola stephanii* is distinguished from this by the 2.5–4 × 0.6–1.2 cm oblanceolate to widely oblanceolate leaves with deeply or coarsely dentate margins, and 5–7 mm long oblong-lanceolate or oblong-ovate petals. In *R. algida* the leaves are linear to linear-lanceolate, 0.8–2 × 0.1–0.3 cm in size, entire or nearly entire along the margins, and the petals are 7–8 mm long, and linear-lanceolate. *Rhodiola dumulosa* differs from *R. algida* in having globose buds in the apex

of rhizomes, and 8–11 mm long petals with acuminate apex.

Maximowicz's α . *altaicum* has hermaphrodite flowers and similar vegetative and reproductive features to *Rhodiola algida*.

Variety β . *jeniseense* was described based on the collections from Baschkauks and Kara-oyuk in Kemtschik water system of a branch of Yenisey River in northern Mongolia by Adrianov in having dioecious nature and wide linear leaves and stamens nearly as long as petals. Although no authentic specimen is deposited in LE, this seems to approach *R. kirilowii* (Regel) Regel ex Maxim., and especially *R. linearifolia* Boriss. in the synonymy, in having a dioecious nature and widely linear leaves.

Maximowicz (1883) also described β . *tanguticum* as dioecious and having narrowly linear leaves and stamens exceeding petals at flowering. I examined all specimens determined as γ . *tanguticum* by Maximowicz and confirmed the dioecious nature except Hancock s. n. from Mt. Siao-wu-tai-shan in North China.

Plants identical with *γ. tanguticum* were collected in Gansu, Qinghai, and eastern part of Xingjiang regions in N China. I found this around lakes of the interior regions of Roqiang in the Altun Shan Mountains in eastern part of Xingjiang. They grew gregariously in rocky gentle slopes with a variety of topographies. The rhizomes are creeping with numerous, closely located cylindrical lateral branches, and then massive when matured. The flowering stems are fastigiate with numerous linear to linear-lanceolate leaves with rounded tip. Some sterile stems also appear from the apex of rhizomes. The inflorescences are compact with 2 to 3 (–5)-flowered peduncles.

As a results of the observations, *γ. tanguticum*, which is clearly distinguishable from *Rhodiola algida* by the dioecious nature and the combination of several vegetative and floral characters, is recognized as a distinct species belonging to the section *Rhodiola* in the subgenus *Rhodiola*. This species, *Rhodiola tangutica*, approaches *Rhodiola angusta* Nakai which ranges in N China (SE Manchuria) and N Korea, and is distinguished by the taller flowering stems, the spreading, nearly entire leaves usually 1–2 mm wide, and the presence of sterile stems.

Rhodiola algida (Ledeb.) Fisch. & C. A. Mey., Enum. Pl. Nov. Schrenk lect. 1: 79 (1841). H. Ohba in J. Jpn. Bot. 55: 296 (1980), excl. *Sedum aligidum* Ledeb. (?)β. *jeniseense* Maxim. in synonymy. Type: Altai. In humidis summorum alpium altaicarum circa fontes fl. Inja, Uba et Sentelex, nei non in alpe ad rivulos Kokorgo. Herb. Fischer (LE–lecto selected by Byalt; BM–probably isolecto).

Sedum aligidum Ledeb. in Fl. Altai. 2: 194 (1830); Icon. Pl. Fl. Ross. t. 418 (1834).

Further synonyms see Ohba (1980).

Chromosome number: $2n = 14$ from the Altai Mountains (Amano et al. 1995).

Other specimens examined: Altai (?). Sine loco specialit. Herb. Bunge s. n. (LE, syn); Herb. Trautvetter s.n. (LE). Altai. Prov. Gorono-Altajsk, Ust-Koksa distr., ad fontes fl. Kutscherla, al. 2300 m. N. Alianskaja et al. s. n. on 8 July 1972 (TI).

Rhodiola tangutica (Maxim.) S. H. Fu in Bull. Bot. Res. Harbin 6 (4): 158 (1986)–K. T. Fu & H. Ohba in Fl. China 8: 260 (2001).

Type: China occidentalis. Terra Tangutorum (Prov. Kansu), decliv. N jugi S a fl. Tetung, regio alpina (10–12,000 ped.), loco humoso in rivulis et fontibus frequens, N. M. Prewalski 649 (LE–lecto selected by Byalt and Grubov [Grubov (2000)]). China occidentalis. Terra Tangutorum (Prov. Kansu). N. M. Prewalski 153, 156, 618, s. n., 15/27 VIII 1872 (LE–syn).

Sedum algidum Ledeb. *γ. tanguticum* Maxim. in Bull. Acad. Sci. St.-Pétersb., Ser. 3, 29: 126 (1883).

Dioecious. Rhizome creeping with numerous, closely located cylindrical lateral branches, then massive when matured. Flowering stems fastigiate, staw-coloured, 10–20 (–30) cm (male), 15–30 cm (female) tall, glabrous, smooth. Sterile stems present. Leaves densely arranged, sessile, lamina flat, linear to linear-lanceolate, 0.8–1.5 cm long, 0.5–2 mm wide, apex rounded or obtuse with acute tip, glabrous, smooth. Inflorescences compact with 2 to 3 (–5) flowered peduncles, obconical, bracteate; pedicels less than 8 mm long. Flowers erect; tubular-like, without ovaries in male; ovaries opposite to petals and without reduced stamens in female. [Male flowers] Calyx tube tapering below, nearly as long as lobes; lobes linear-oblong, 2.5–3 mm long, ca. 0.5 mm wide. Petals erect, usually pale red-purple, oblong-lanceolate, 6–8 mm long, ca. 1.3 mm wide, apex acuminate with rounded tip. Stamens 1.5–2 times longer than petals, erect, anthers globose, ca. 0.5 mm long, red-purple before dehiscence. Nectar scales quadrate, ca. 0.6 mm long, apex emarginate. [Female flowers]

Calyx-tube obconical, lobes ascending, narrowly triangular or triangular-lanceolate, 3–3.5 mm long, ca. 0.6 mm wide. Petals erect, usually white with red-purplish tip and margins, oblong-lanceolate, 6–8 mm long, ca. 1.3 mm wide, apex obtuse. Nectar scales same as those of male. Ovaries erect, narrowly lanceolate, 7–9 mm long; styles slender erect, ca. 1.5 mm long. Follicles ca. 1 cm long with remaining styles.

Specimens examined: China. Qinghai: Maqin (Magen) Xian: Nizhuoma Pass, between Maqin (Magen) and Changmahe (Qumalung), alt. 4780–4900 m, 34°34'51"N 99°27'3"E. T. N. Ho, B. Bartholomew & M. Gilbert 759 (E, A); Xueshan Xiang, W of Maqin (Magen), Caigongka, alt. 4300–4600 m, 34°38'N 99°44'E. Ho, Bartholomew & Gilbert 453 (E, A); Madio (Madio) Xian, Huoluoguoqai, Qingshui Xiang, between Dari (Darlag) and Huashixia, alt. 4600–4730 m, 34°49'22"N, 99°2'34"E. Ho, Bartholomew & Gilbert 1360 (E, A); Dari (Darlag) Xian, Mobadong Shan, Deang (Dernang) Xian between Dari (Darlag) and Banma (Baima), alt. 4400–4700 m, 33°22'37"N, 100°17'24"E. Ho, Bartholomew & Gilbert 1262 (E, A), Xinghai Xian, Wenquan Xiang, along the Qulong He, just NE of Wequan on the road to Daheba, alt. 4010 m, 35°25'15"N, 99°28'1"E. Ho, Bartholomew & Gilbert 1400 (E, A); Madio Xian, Doucuo, Heihai Xiang, between Wenquan and Huashixia, alt. 4130 m, 35°21'21"N, 99°8'2"E. Ho, Bartholomew & Gilbert 1434 (E, A); Chindu Xian, Qingshuihe Xiang: W of road between Madoi and Yushu on road to Zadoi just S of ; just S of Qingshuihe, alt. 4300 m, 33°45'N, 97°7'E. Ho, Bartholomew, Watson & Gilbert 1595 (E, A, TI); Chindu Xian, Qingshuihe Xiang: W of road between Madoi and Yushu on road to Zadoi just S of Qingshuihe, alt. 4350 m, 33°45'N, 97°3'E. Ho, Bartholomew, Watson & Gilbert 1658 (E, A, TI); Chindu Xian: Xiwu Xiang, road between Xiwu and the Sichuan border, ca. 26 km E from Yushu-Xining highway (highway 214), alt. 4470 m, 33°10'13"N, 97°32'33"E. Boufford, Lu & Ying 26923 (A).

(8) *Rhodiola krivochizhinii* Sipliv.

Siplivinsky (1974) distinguished this from *Rhodiola atropurpurea* (Turcz.) Trautv. & C. A. Mey. in having small and yellowish flowers and green not glaucous leaves. Ohba (1981) reduced this to a synonym of *Rhodiola rosea* L. Gontcharova (1999)

regarded this as the subspecies of *Rhodiola rosea*.

The type specimen deposited in LE is a male plant and falls within the range of variations of *Rhodiola rosea* in most significant characters. The remarkable features which differ from *R. rosea* are the compact male inflorescence and the shape of cauline leaves. The cauline leaves are oblong-elliptic, 1.5–2 cm long, 0.8–1.3 cm wide, and with subacute apex and few toothed margins near the apex. These two characters are similar to those of *R. heterodonta*.

As treated in my previous paper (Ohba 1981), *R. krivochizhinii* is regarded as a synonym of *R. rosea*. Further information on local variations, morphological and cytological features are needed to establish the infraspecific taxa in the cosmopolitan *Rhodiola rosea*.

***Rhodiola rosea* L., Sp. Pl. 1035 (1753):** H. Ohba in J. Fac. Sci. Univ. Tokyo, Sect. III, (1991).

Rhodiola krivochizhinii Sipliv. in Novit. Syst. Pl. Vasc. Acad. Sci. URSS. Inst. Komarov. 11: 313 (1974).

Type: Mare Beringense prope sinum Korfii, insula Verchoturovii, in decliviis lapidosis ad littorem maris. (A. Krivochizhin s. n., 29–30 VI, 1970, male, LE).

Rhodiola rosea L. subsp. *krivochizhinii* (Sipliv.) Gontch. in Bull. Natn. Sci. Mus. Tokyo, Ser. B, 25: 56 (1999).

(9) *Sedum trollii* Werdermann

The Crassulaceae (Sarwar 2002), in the recent issue of Flora of Pakistan edited by S. I. Ali and M. Qaiser, treats the Crassulaceous flora of Pakistan very thoroughly. *Rhodiola* is the largest genus consisting of 12 species. Two *R. pachyclados* (Aitch. & Hemsl.) H. Ohba and *R. saxifragoides* (Fröd.) H. Ohba, are endemic to Pakistan. Recently I have become aware of taxa unrecorded in Sarwar (2002).

This is *Sedum trolia* Werderm. Werdermann (1939) described this based on a collection by K(C)arl Troll from Nanga Parbat, Pakistan in 1937. As the type was destroyed, the identity is still uncertain.

Werdermann (1939) indicated that the species is similar to *Rhodiola pachyclados*, but differs in having few (1 or 2 against 2 to 10) flowers and much smaller carpels, “von *S. pachyclados* unterscheidet sie sich hauptsächlich durch die ungerzähnten Blätter, stets armlütige Infloreszenzen (1–2 gegen 2–10 Blüten) und viel kleinere Karpelle.” However, the number of flowers in each flowering stem is usually 2 or 3 in *R. pachyclados*, and the size of carpels are variable. The name *sedum trollii* as used in horticulture refers both to the true *S. trollii* and also to *R. pachyclados*. These two are in fact conspecific and share a dwarf habit with a rather conspicuous rosette and hermaphrodite flowers. *Rhodiola pachyclados*, is illustrated as *Sedum trollii* by Stephenson (1994, Plate 109).

Rhodiola pachyclados (Aitch. & Hemsl.) H. Ohba in J. Jpn. Bot. **51**: 383 (1976); Sarwar in Ali & Qaiser, Fl. Pakist. No. 209, 31 (2000).

Sedum trollii Werderm. in Notizbl. Bot. Gart. Berlin **14**: 349 (1939), syn. nov.

Type: Nanga-Parbat-Gebiet, Lichar-Tal.: Doyan-Kamm, Felsenheide, lockere Polster an Felsen bildend. 3200 mü. M., C. Troll n.

7583, blühend am 23. Juni 1937 (B[†]).

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大場秀章：アジア産ベンケイソウ科植物の分類覚書 (3)

(7) *Sedum algidum* Ledeb. とその変種として記載された *γ. tanguticum* Maxim. についてはこれまで不明の点が多く、分類学的な見解も定まっていなかった。タイプ標本の検討と多くの標本、自生地の観察から両者が亜属を異にする独立種であることを明らかにした。後者は *Rhodiola tangutica* が正名となり、その記載を行った。(8) *Rhodiola krivochizhinii* Sipliv. はベリリング海の Verchoturo-

vii 島から記載されたが、改めてタイプを検討しイワベンケイの異名とした。(9) Werdermann が1939年にパキスタンのナンガパルバットから記載した *Sedum trollii* が、カラコルム山脈に固有な *Rhodiola pachyclados* (Aitch. & Hemsl.) H. Ohba の異名であることを明らかにした。

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